

Apps, Trackers, Privacy, and Regulators

A Global Study of the Mobile Tracking Ecosystem

Abbas Razaghpanah, Rishab Nithyanand, Narseo Vallina-Rodriguez, Srikanth Sundaresan, Mark Allman, Christian Kreibich, Phillipa Gill

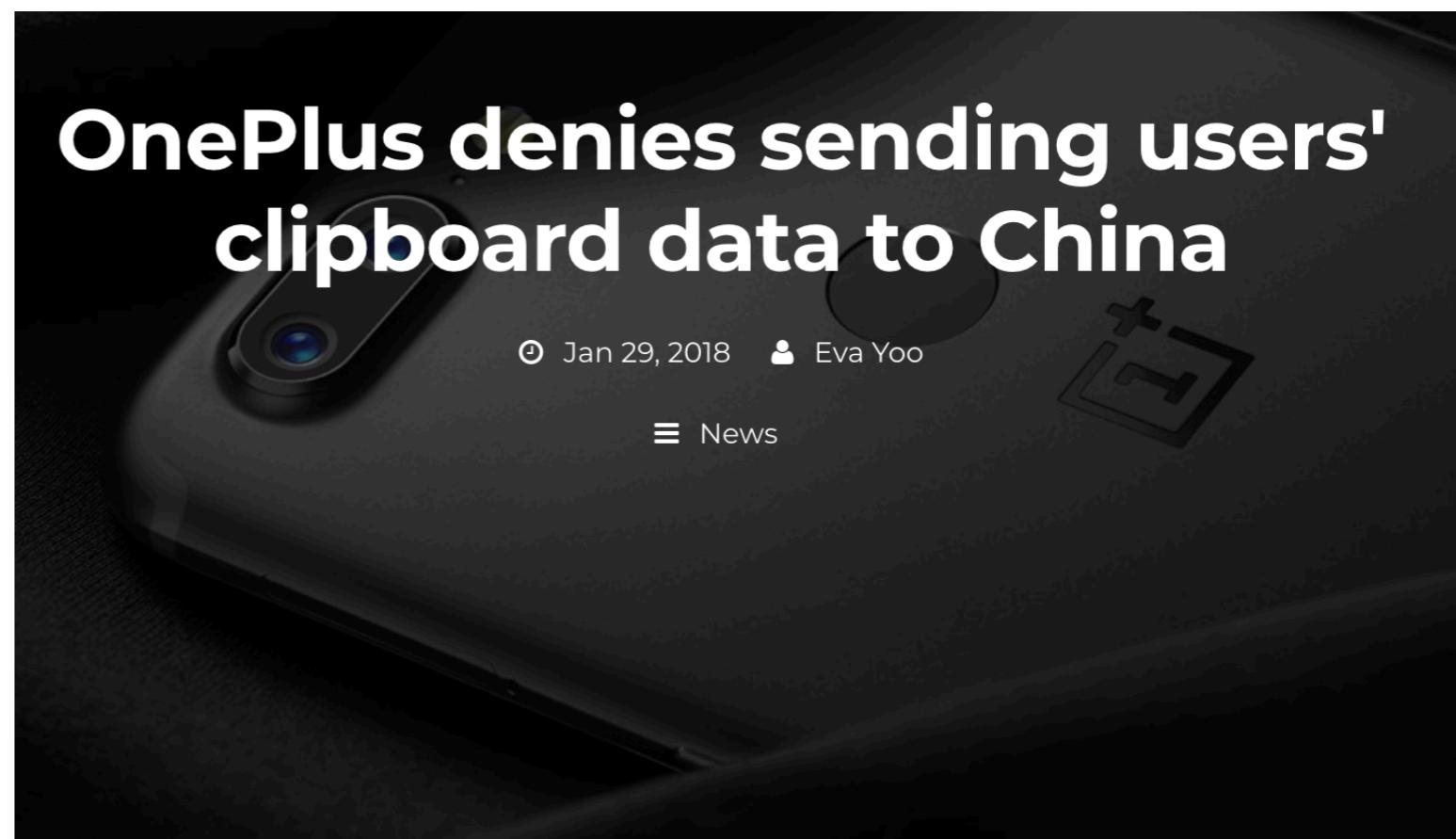


Data&Society

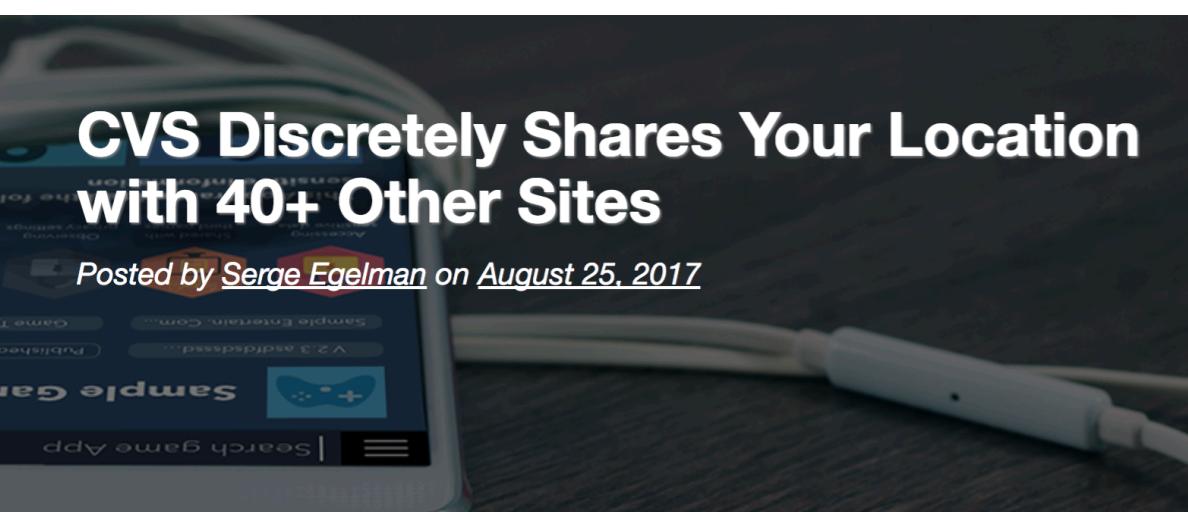


Mobile tracking

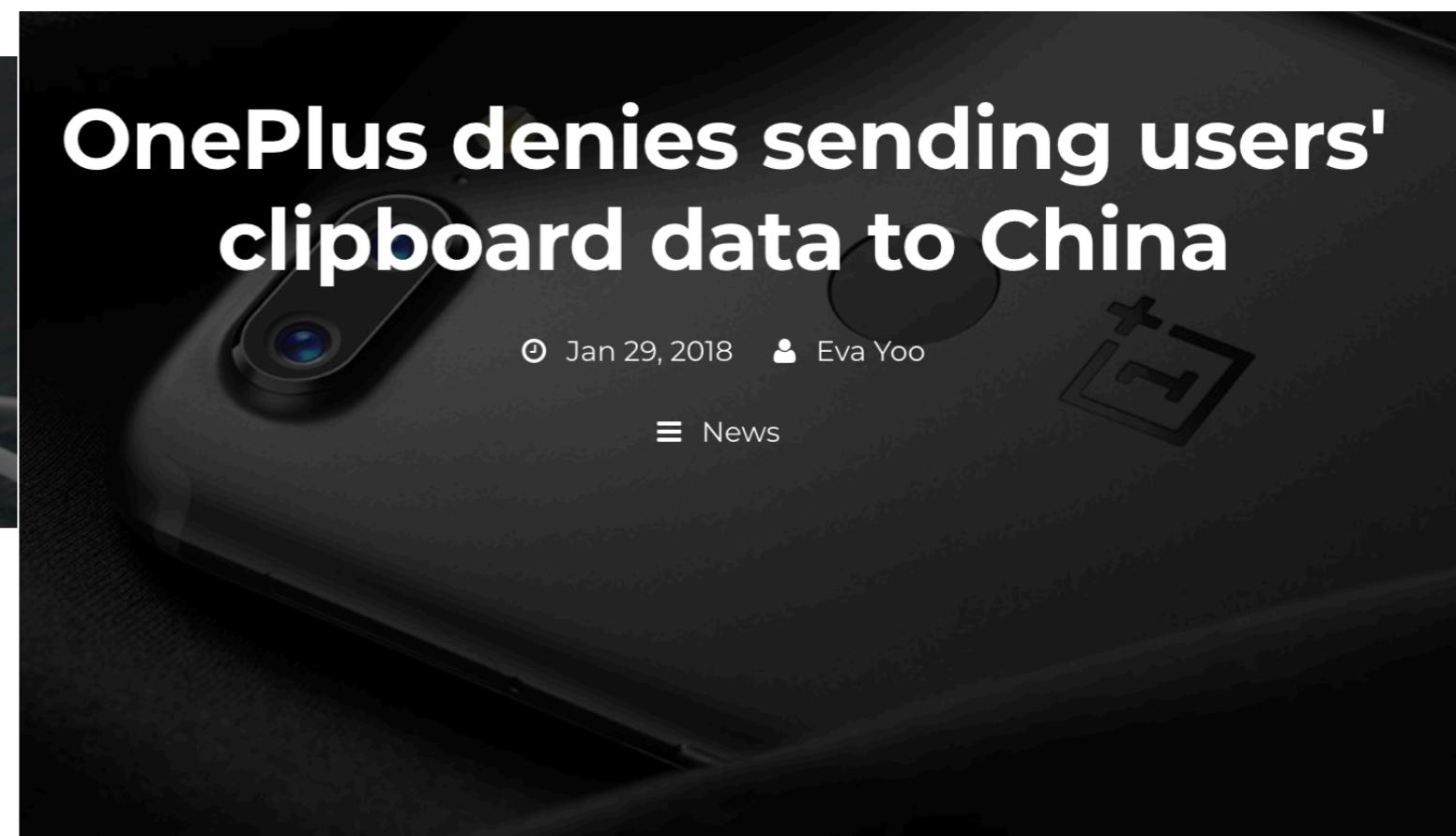
Mobile tracking



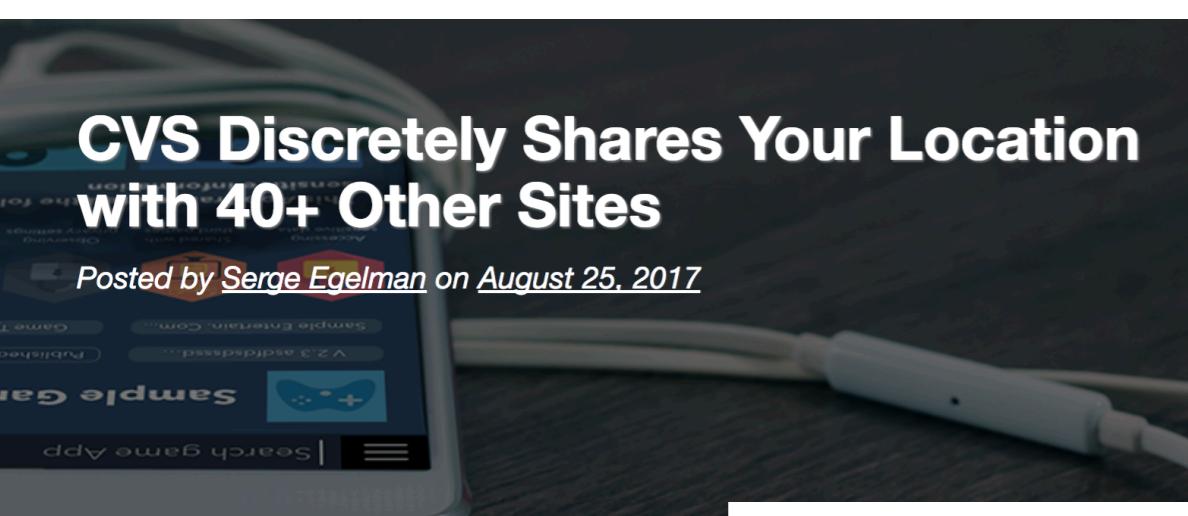
Mobile tracking



Recently, we decided to take a closer look at apps in our database that are sharing location data. This is a concern, because it could be used to track



Mobile tracking



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Why is this company tracking where you are on Thanksgiving?

A data collection service called SafeGraph collected 17 trillion location markers for 10 million smartphones during the holiday last year.





FIFA Soccer

ELECTRONIC ARTS Sports

E Everyone

Offers in-app purchases

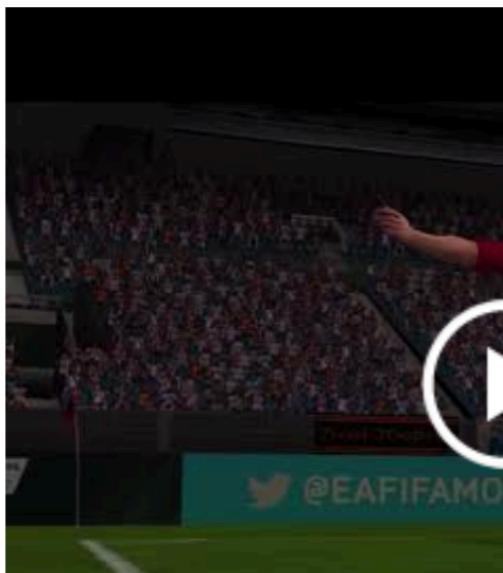
This app is compatible with all of your devices.

Editors' Choice

★★★★★ 3,059,307

Add to Wishlist

Install



Privacy Policy

PLEASE NOTE THAT THIS PRIVACY POLICY APPLIES ONLY TO THOSE USERS OF THE SERVICES WHO ARE AGE 13 AND OLDER. SPECIAL PROCEDURES ARE USED WHEN COLLECTING INFORMATION FROM USERS UNDER THE AGE OF 13, WHICH ARE DISCUSSED IN THE "POLICIES REGARDING CHILDREN UNDER THE AGE OF 13" SECTION BELOW.

Privacy Policy

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This Privacy Policy explains how we may collect, use, store, disclose and manage the personal information ("Personal Information") you provide to us when using, or about to using, any of our applications, games or software (collectively, the "Services"). Whenever you access or use our website and domain name, and any of the Services, you agree to allow us to collect, use, store, disclose and manage your Personal Information as explained in this Privacy Policy, and accept this Privacy Policy in registration or game installation.

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More than meets the eye

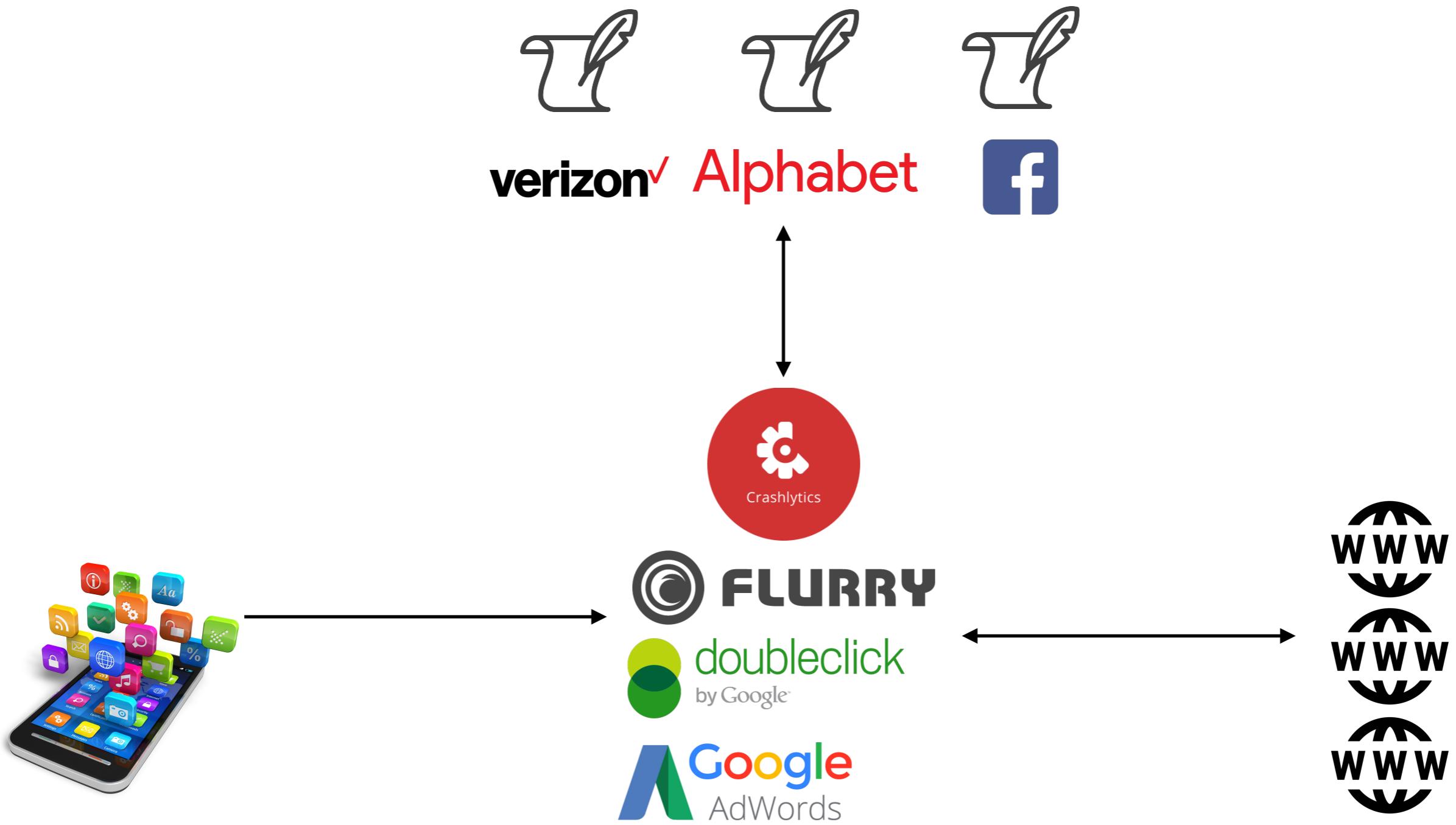
- 90% of mobile apps are free, many are monetized using ads
- Apps use 3rd-party services to collect tracking data and display ads
 - **Advertising and Tracking Services (ATS, for short)**
 - Not visible to the users
 - Data sharing policies are unknown to the users and researchers
- No complete study of mobile tracking and advertising ecosystem

More than meets the eye

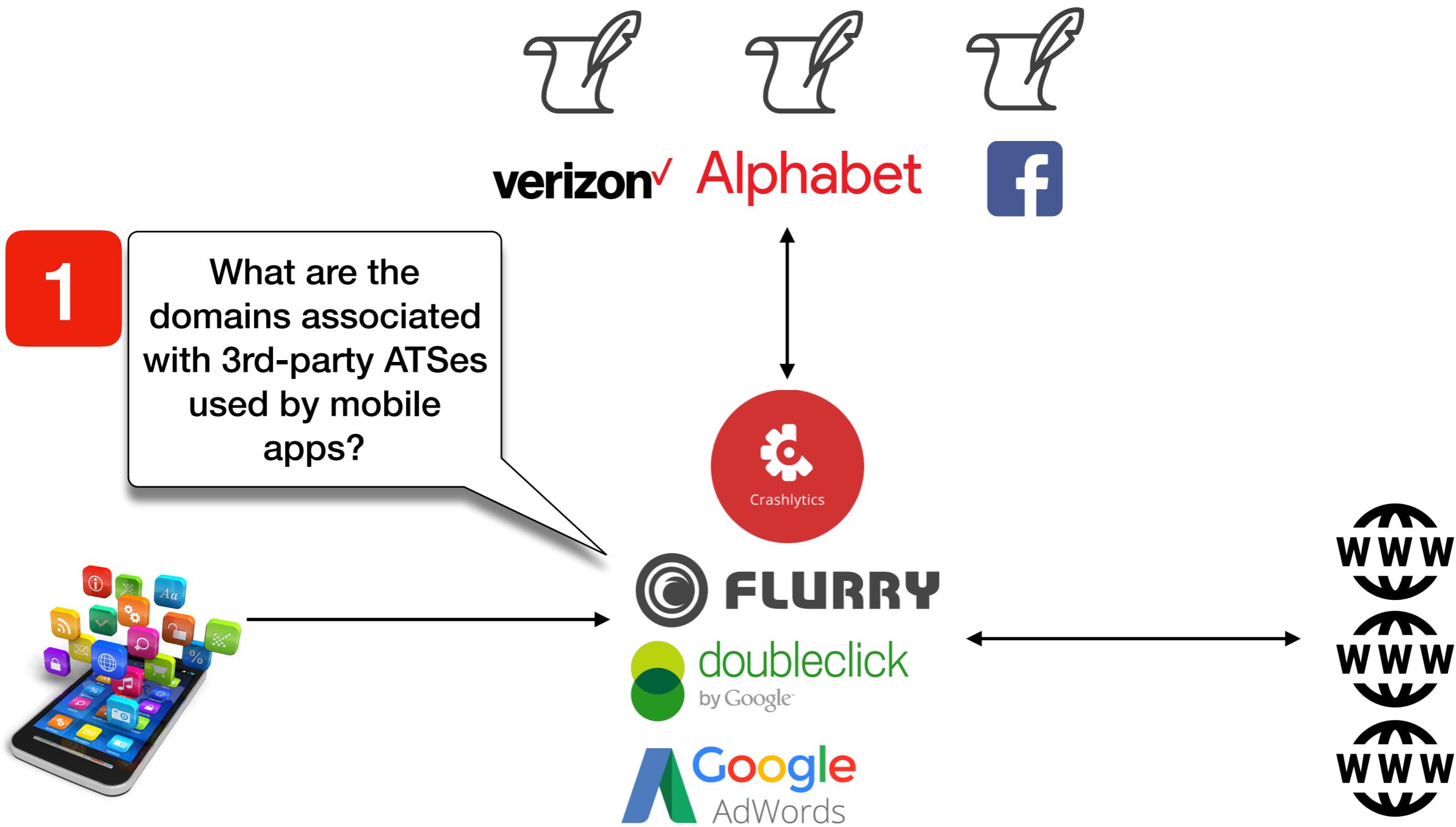
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We aim to bring transparency to this ecosystem.

Questions to answer



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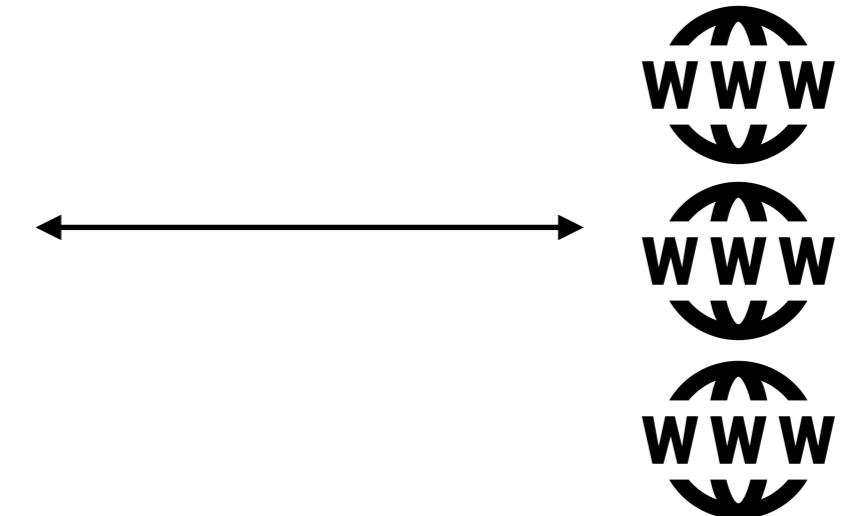
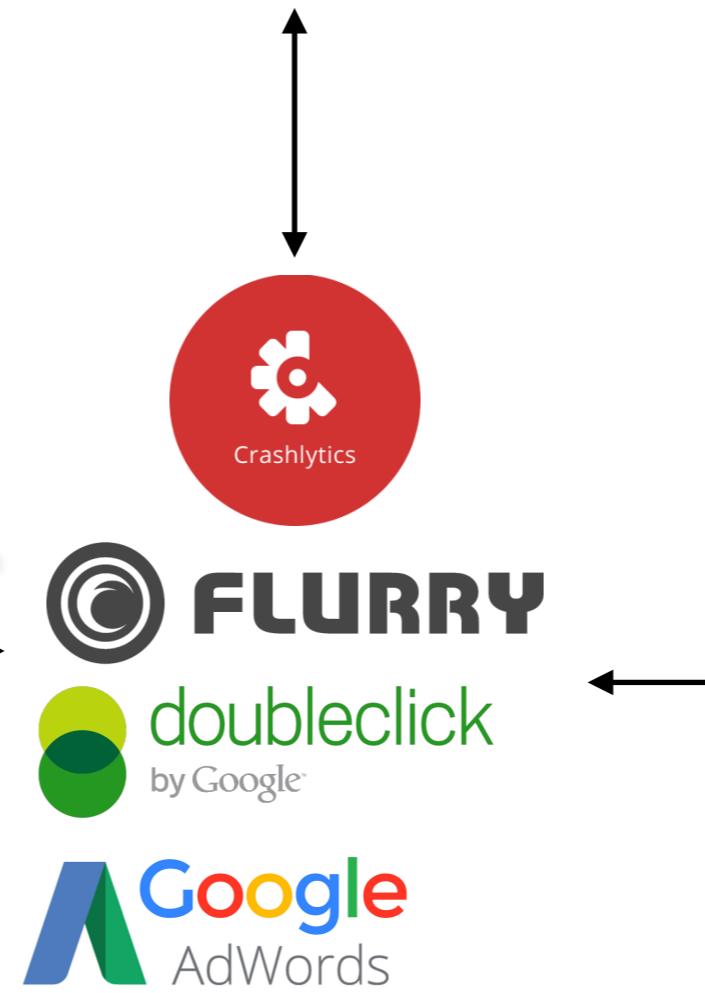
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What are the domains associated with 3rd-party ATSes used by mobile apps?



Questions to answer

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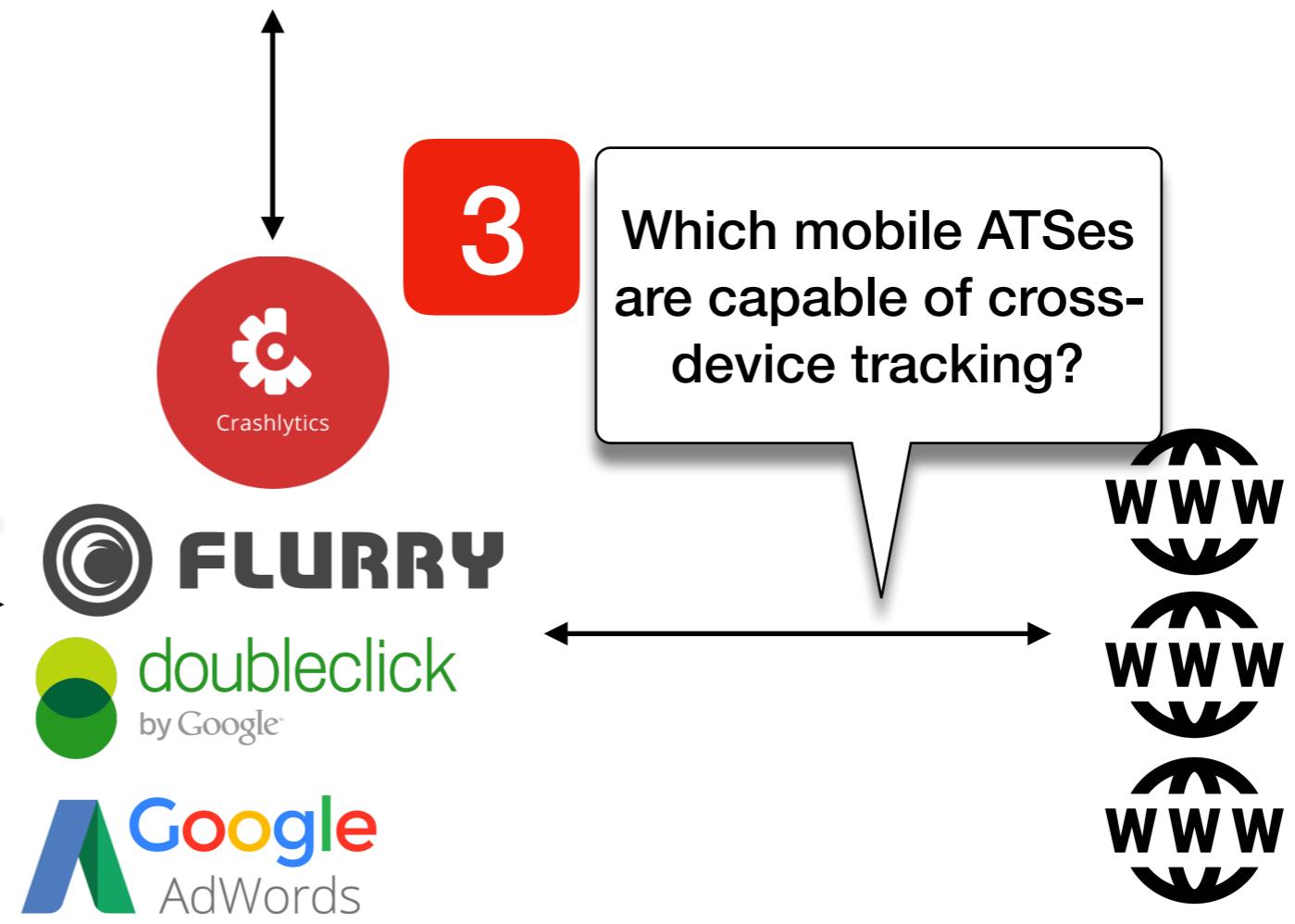
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Which mobile ATSes are capable of cross-device tracking?



Questions to answer

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verizon^v **Alphabet**

4

What do their privacy policies look like?



3

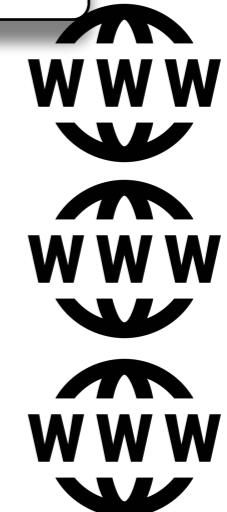
Which mobile ATSes are capable of cross-device tracking?



FLURRY

doubleclick
by Google

Google
AdWords



Existing datasets are incomplete and/or inaccurate

McAfee Trusted Source

URL	Category
http://flurry.com	Internet Services
http://cloudflare.com	Internet Services

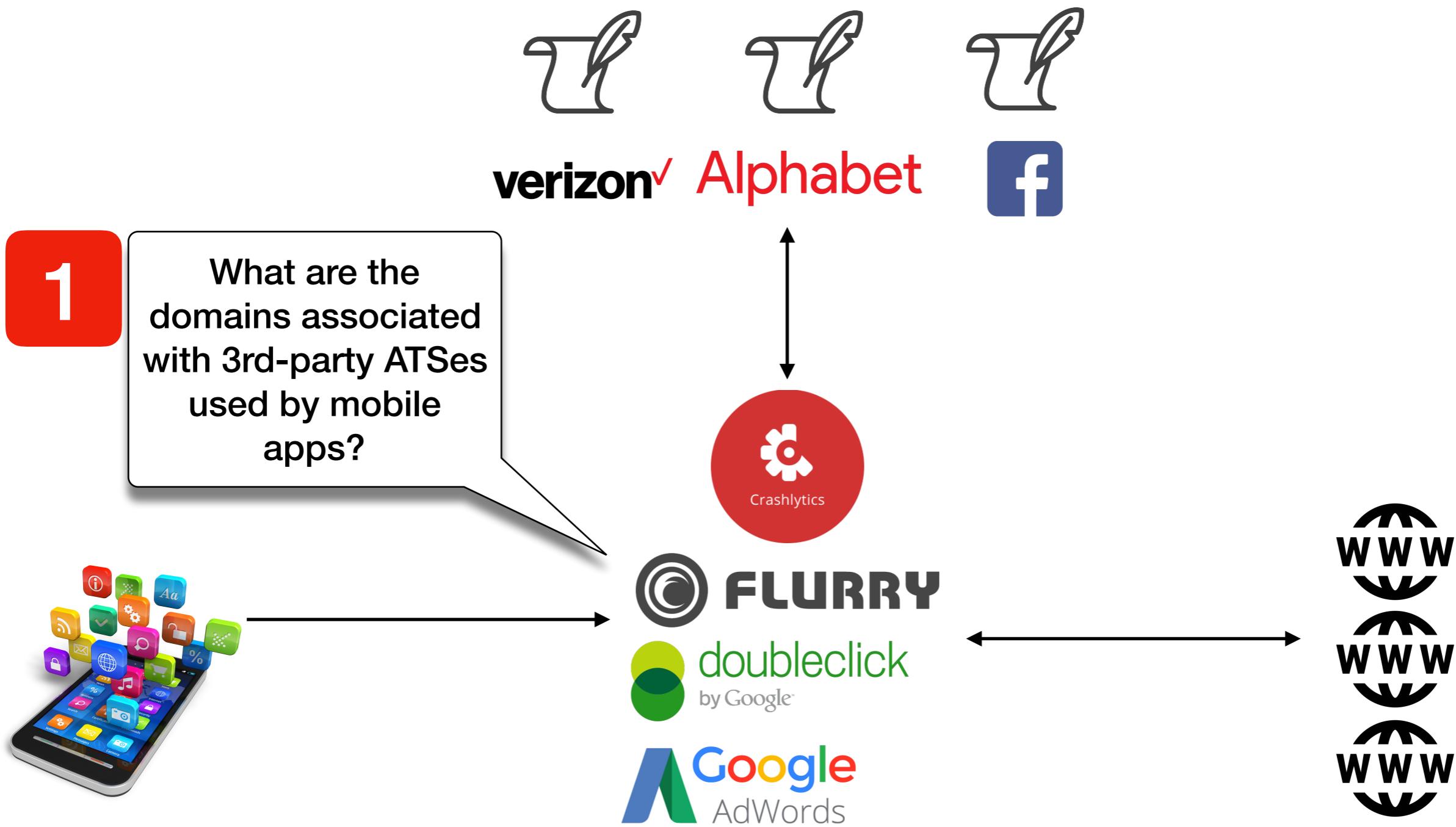
AdBlock Plus (EasyList)

URL	Category
http://flurry.com	None
http://cloudflare.com	None

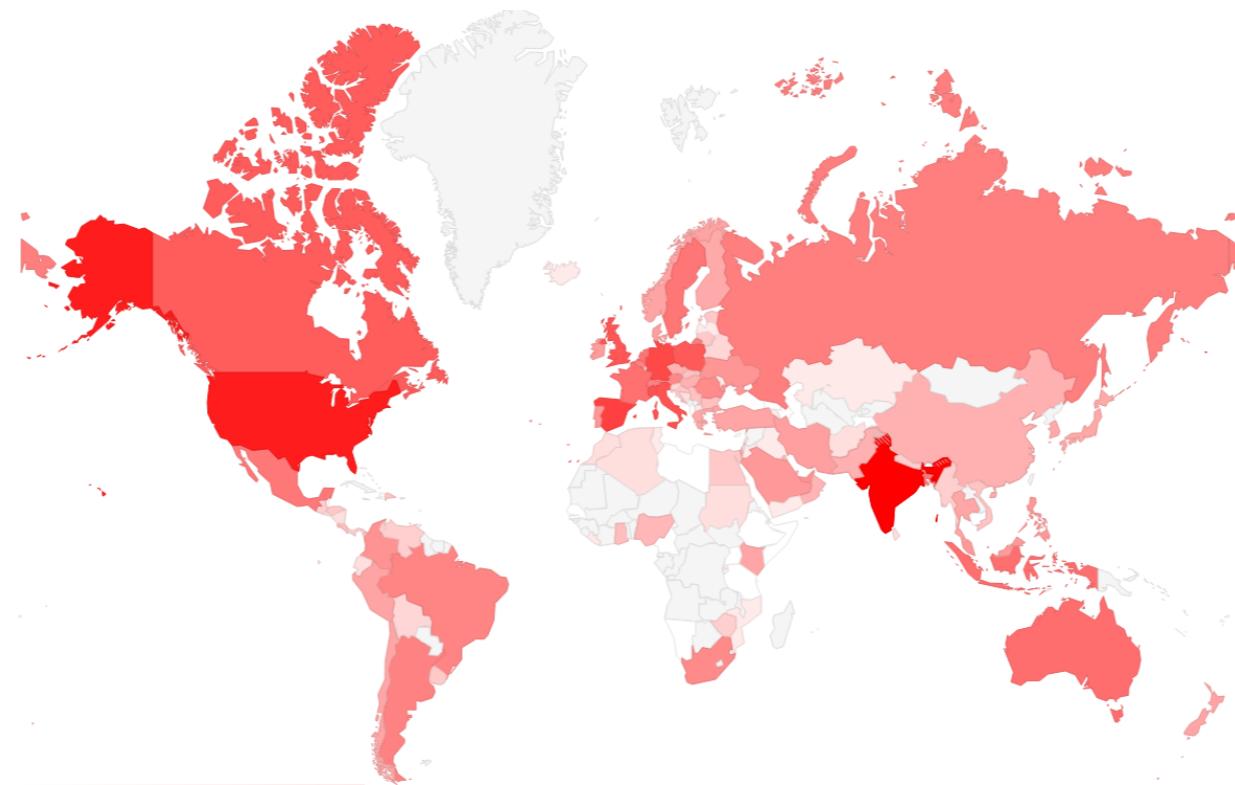
OpenDNS Domain Tagging

URL	Category
http://flurry.com	Software/Technology, Advertising, Business Services
http://cloudflare.com	Business Service

Questions to answer

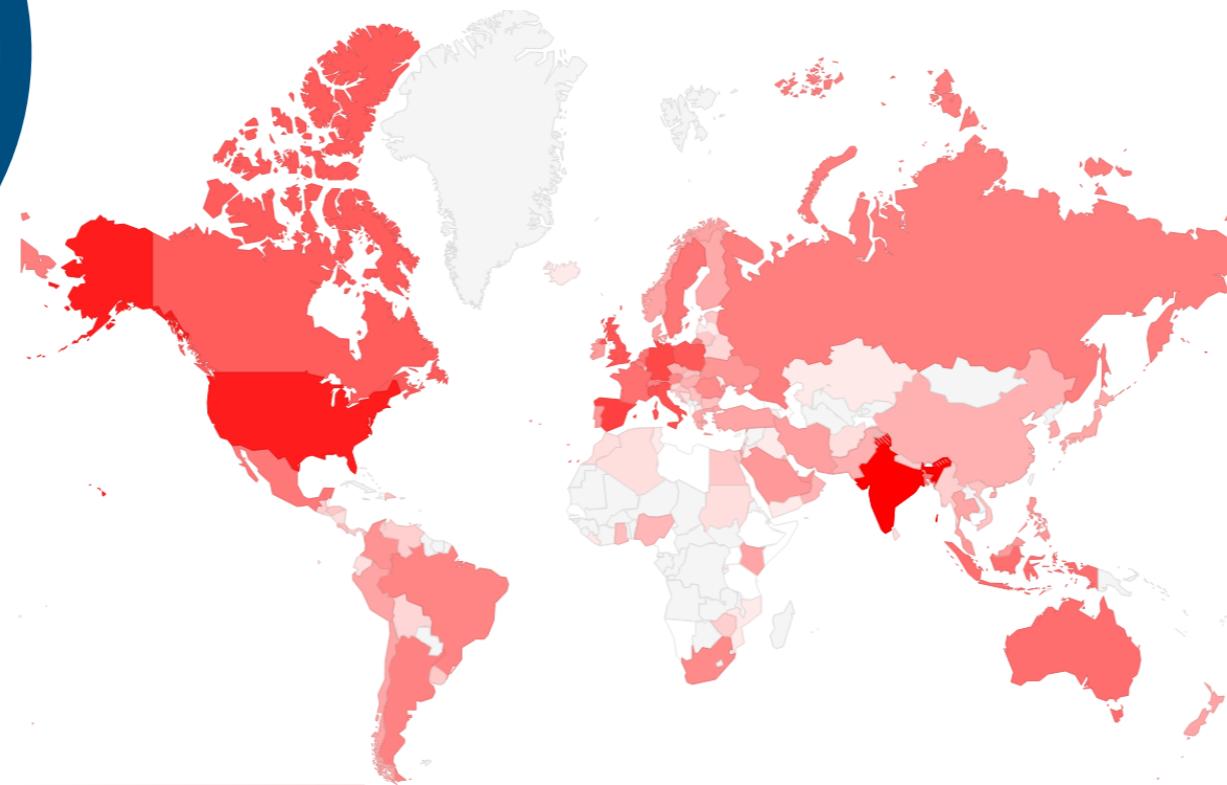


Lumen Dataset



Lumen Dataset

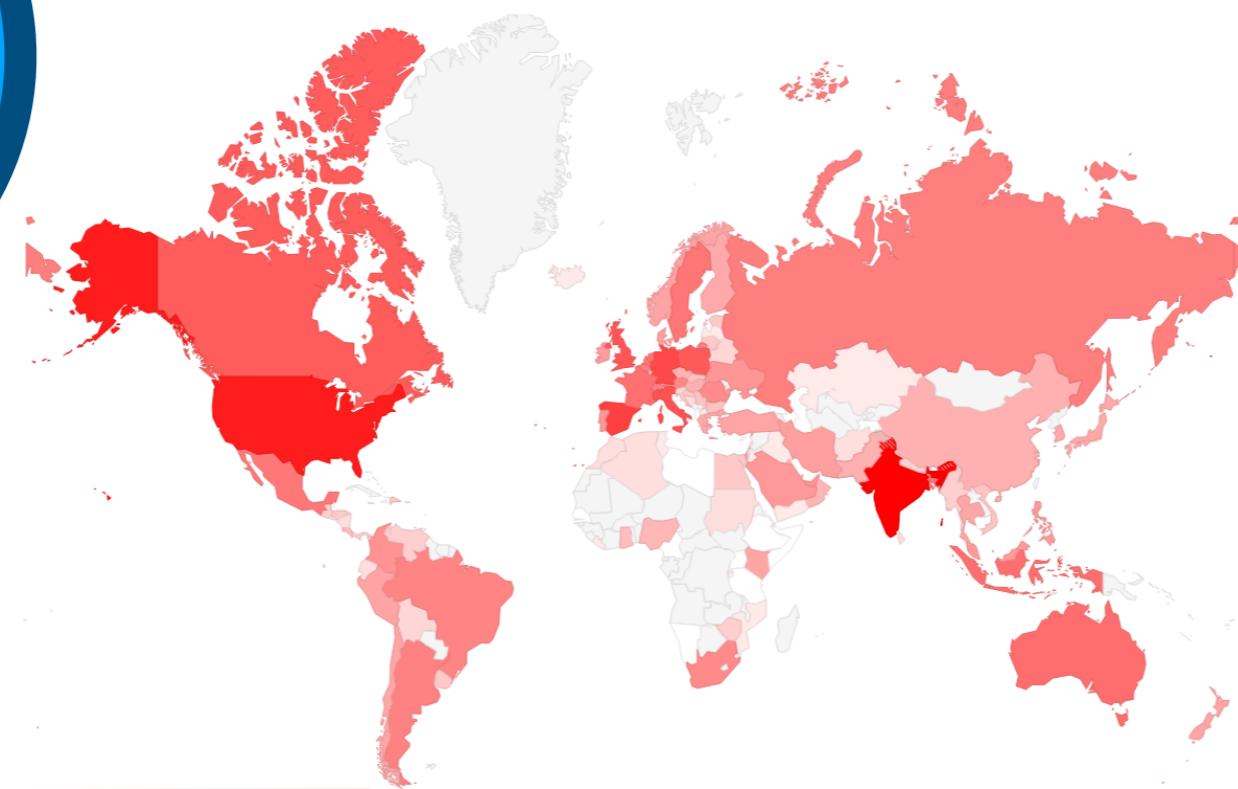
12,000
users



Lumen Dataset

12,000
users

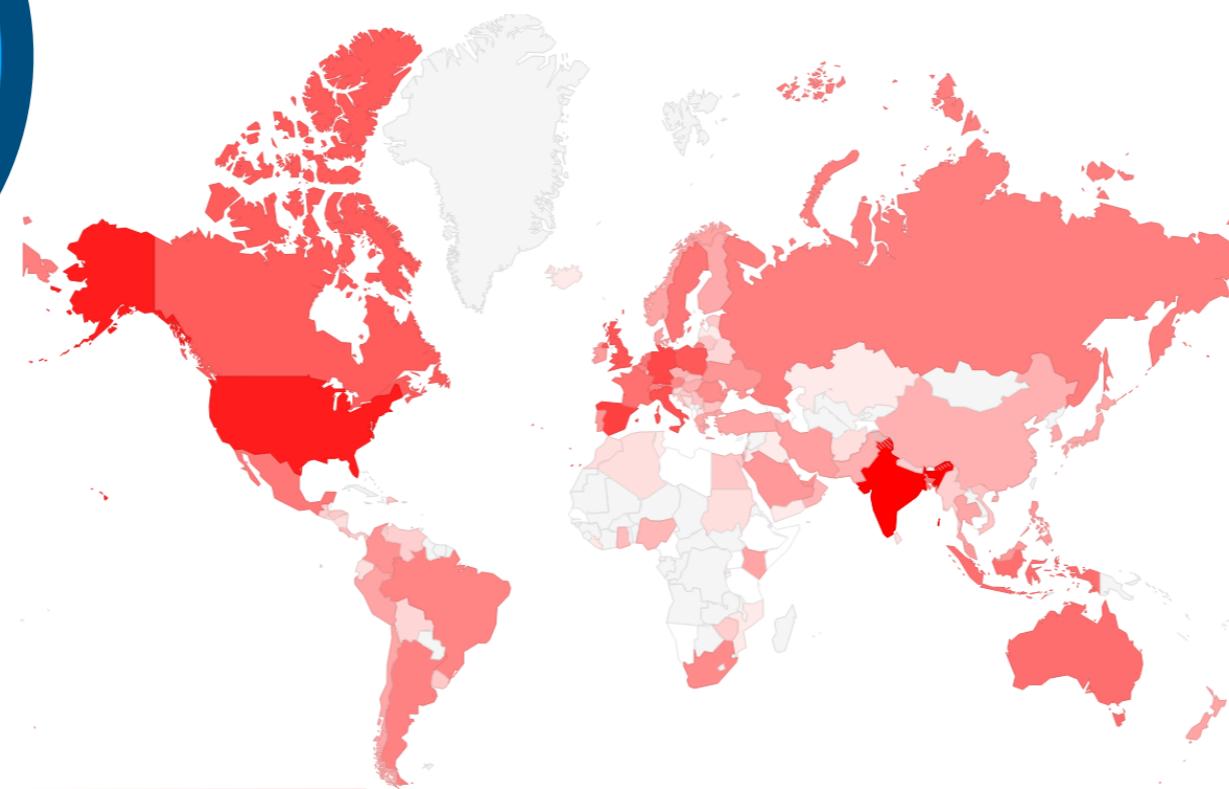
14,000
apps^[1]



[1] 48% of apps have at least 1M installs

Lumen Dataset

12,000
users



14,000
apps^[1]

40,000
domains^[2]

[1] 48% of apps have at least 1M installs

[2] Top-10K domains are found on iOS traffic and account for 65% of total monthly traffic on a EU MNO

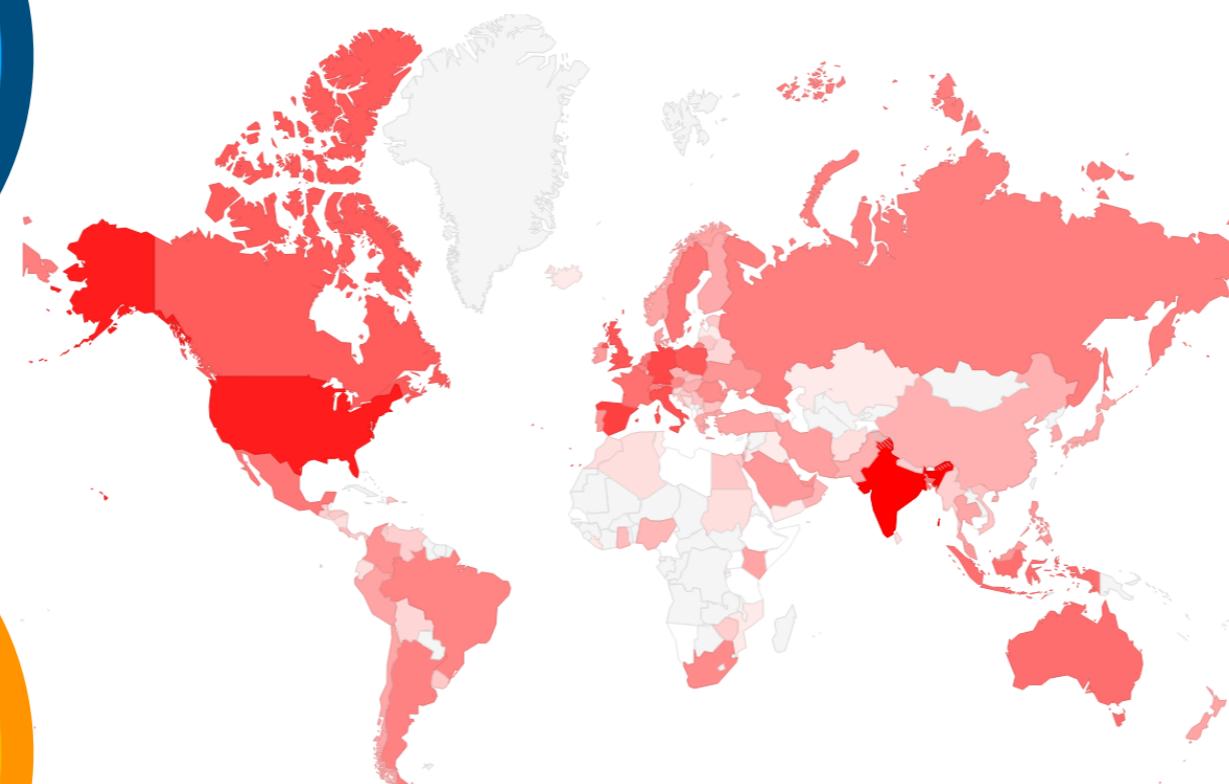
Lumen Dataset

12,000
users

14,000
apps^[1]

8.5M
flows

40,000
domains^[2]



[1] 48% of apps have at least 1M installs

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Lumen Privacy Monitor

Int. Computer Science Institute-UC Berkeley Tools

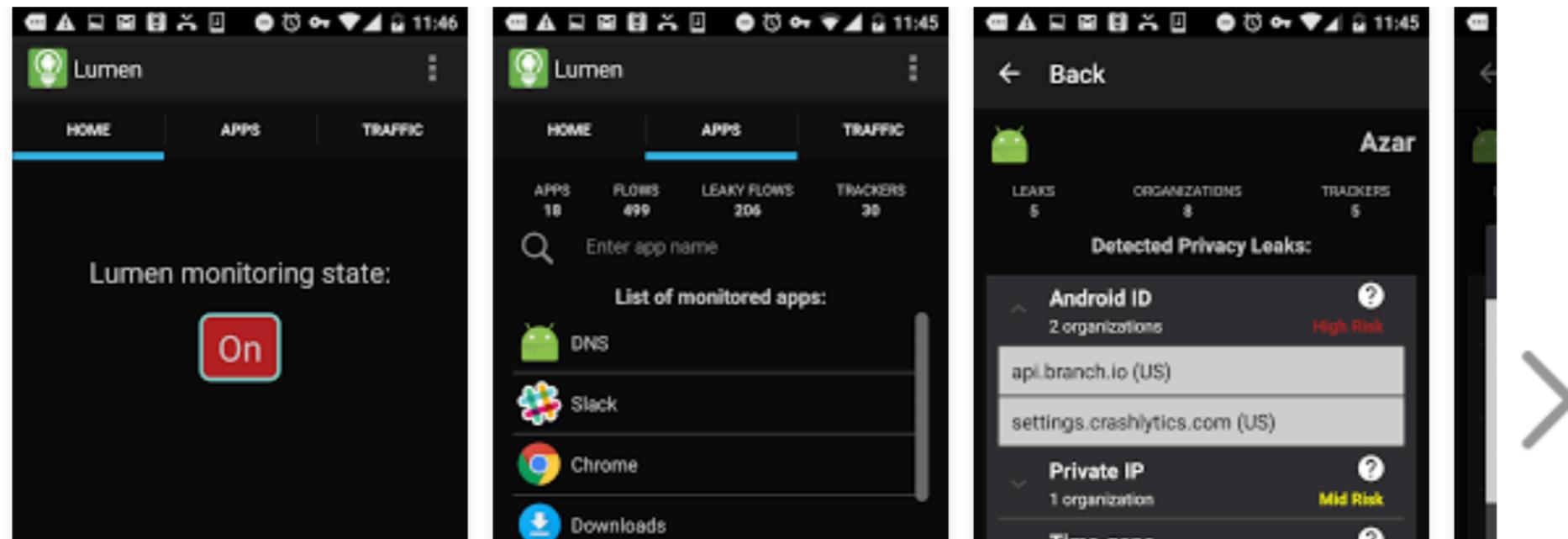
★★★★★ 85

Everyone

This app is compatible with all of your devices.

Add to Wishlist

Install



DATA
TRANSPARENCY
LAB

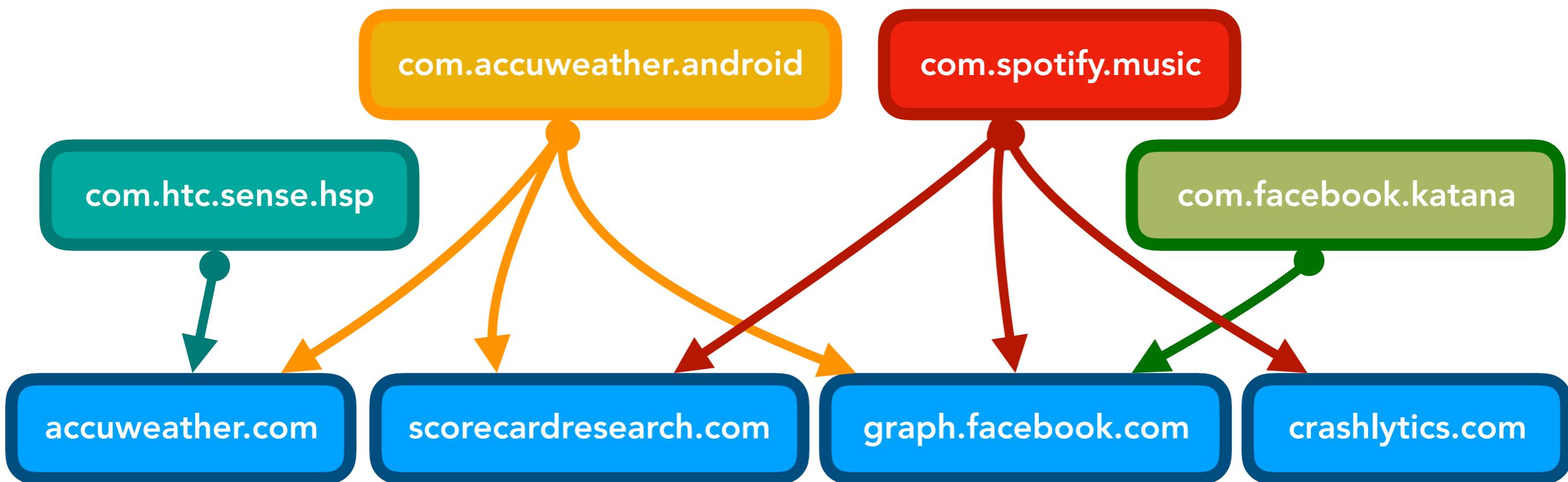


Funded by the Horizon 2020
Framework Programme of the
European Union

How we identified advertising and tracking services

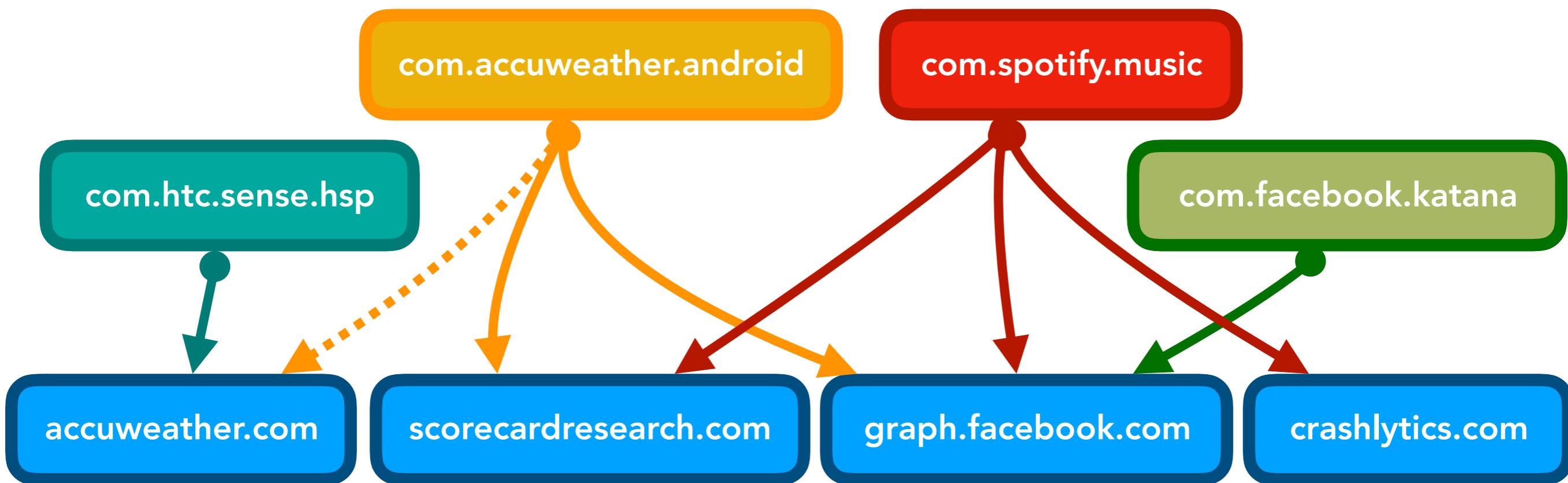


Identifying 3rd-Party Services



Identifying 3rd-Party Services

Step 1: Distinguish between 1st-party domains and 3rd-party ones



***.accuweather.com**
Issued by: DigiCert SHA2 Secure
Expires: Sunday, August 25, 2019
Daylight Time
This certificate is valid

▼ Details

Subject Name _____
Country US
State/Province Pennsylvania
Locality State College
Organization Accuweather, Inc.



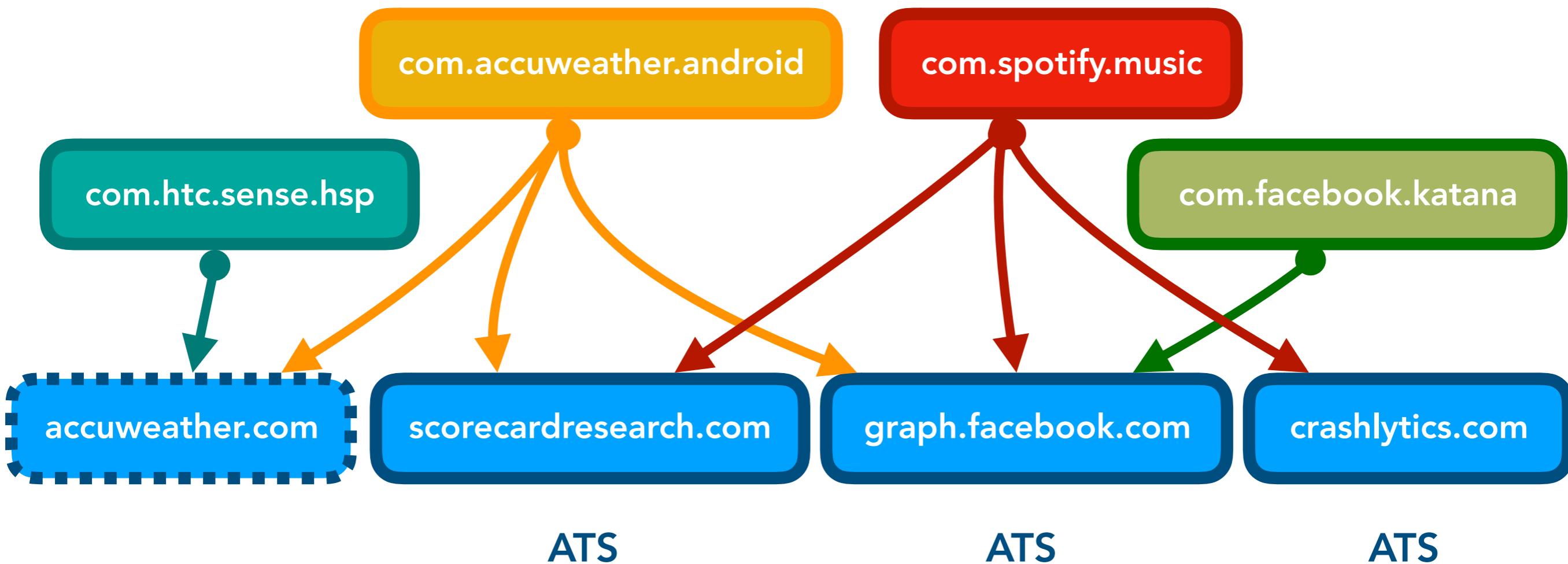
***.facebook.com**
Issued by: DigiCert SHA2 High
Expires: Friday, March 22, 201
This certificate is valid

▼ Details

Subject Name _____
Country US
State/Province California
Locality Menlo Park
Organization Facebook, Inc.

Identifying 3rd-Party Services

Step 2: Separate ATS and ATS-Capable domains from other 3rd-party services using ML



ATSes discovered

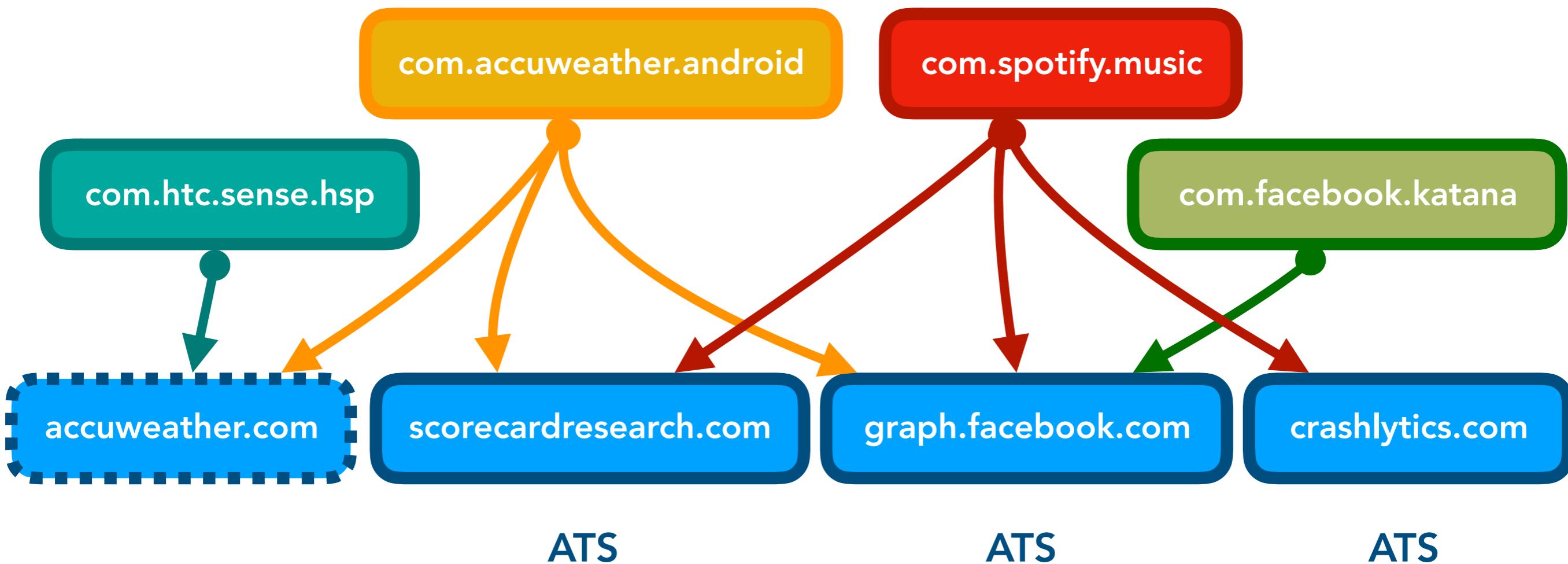
Domains	3rd-party domains	ATS second-level domains	ATS-Capable second-level domains
40,553	8,099	2,121	730

ATSes discovered

Domains	3rd-party domains	ATS second-level domains	ATS-Capable second-level domains
40,553	8,099	2,121	730
Coverage	EasyList	38%	24%
	hpHosts	77%	35%

Identifying 3rd-Party Services

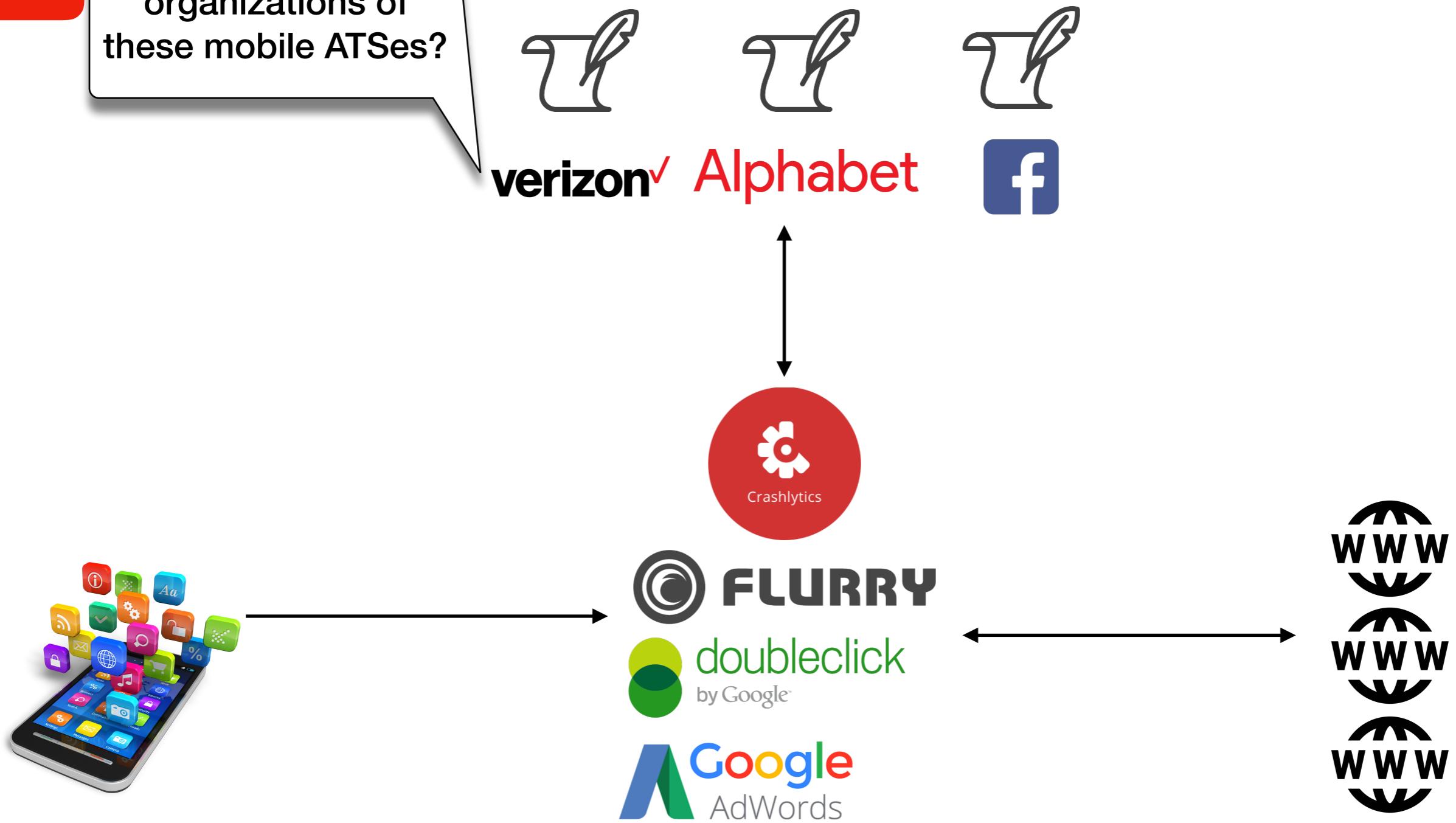
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Questions to answer

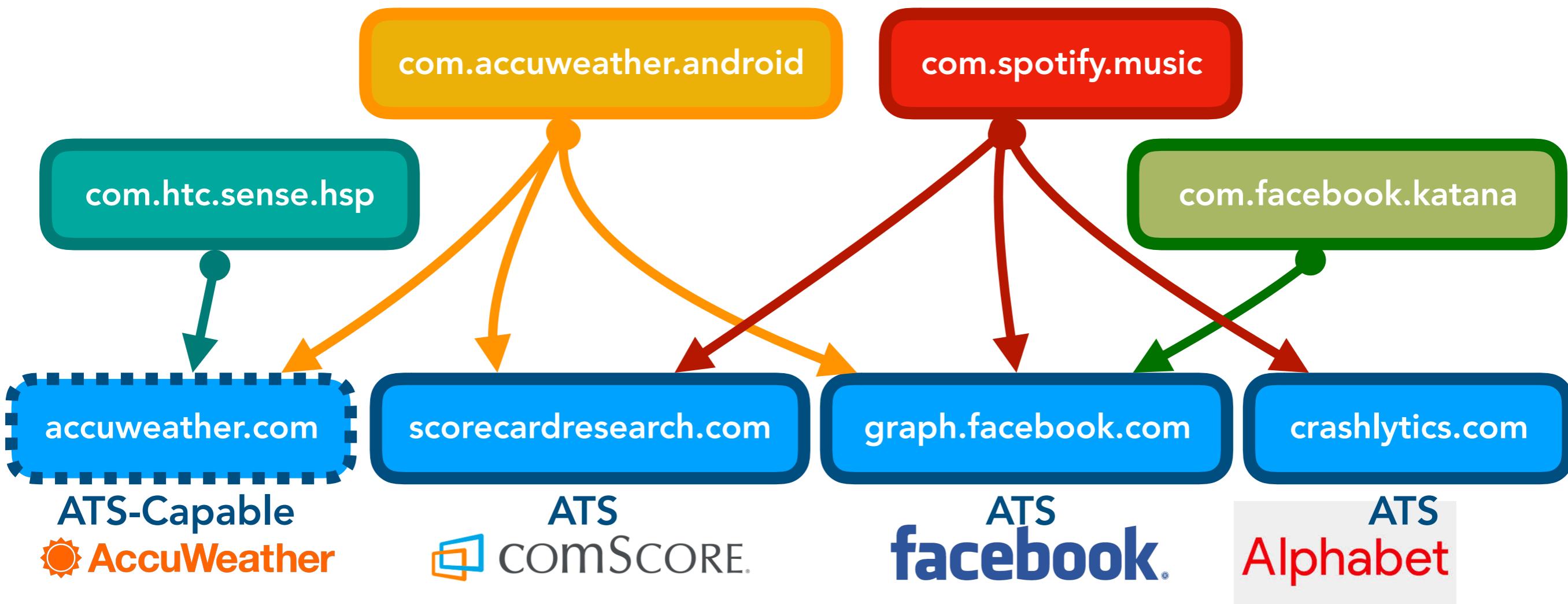
2

Who are the parent organizations of these mobile ATSes?



Identifying Parent Companies

Identify parent company



tracker . com



Hoovers™
A D&B COMPANY
crunchbase

Tracker and Sons ®

ATS parent companies

- **292 parent orgs. own nearly 2,000 ATSes**
- As expected, big companies dominate, but...



#1



#4

ATS parent companies

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#1

Alphabet

#4

verizon✓

ATS parent companies

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#1 Alphabet

#4 verizon



Aol.

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verizon✓

Aol.

YAHOO!

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verizon✓**Aol.****YAHOO!**

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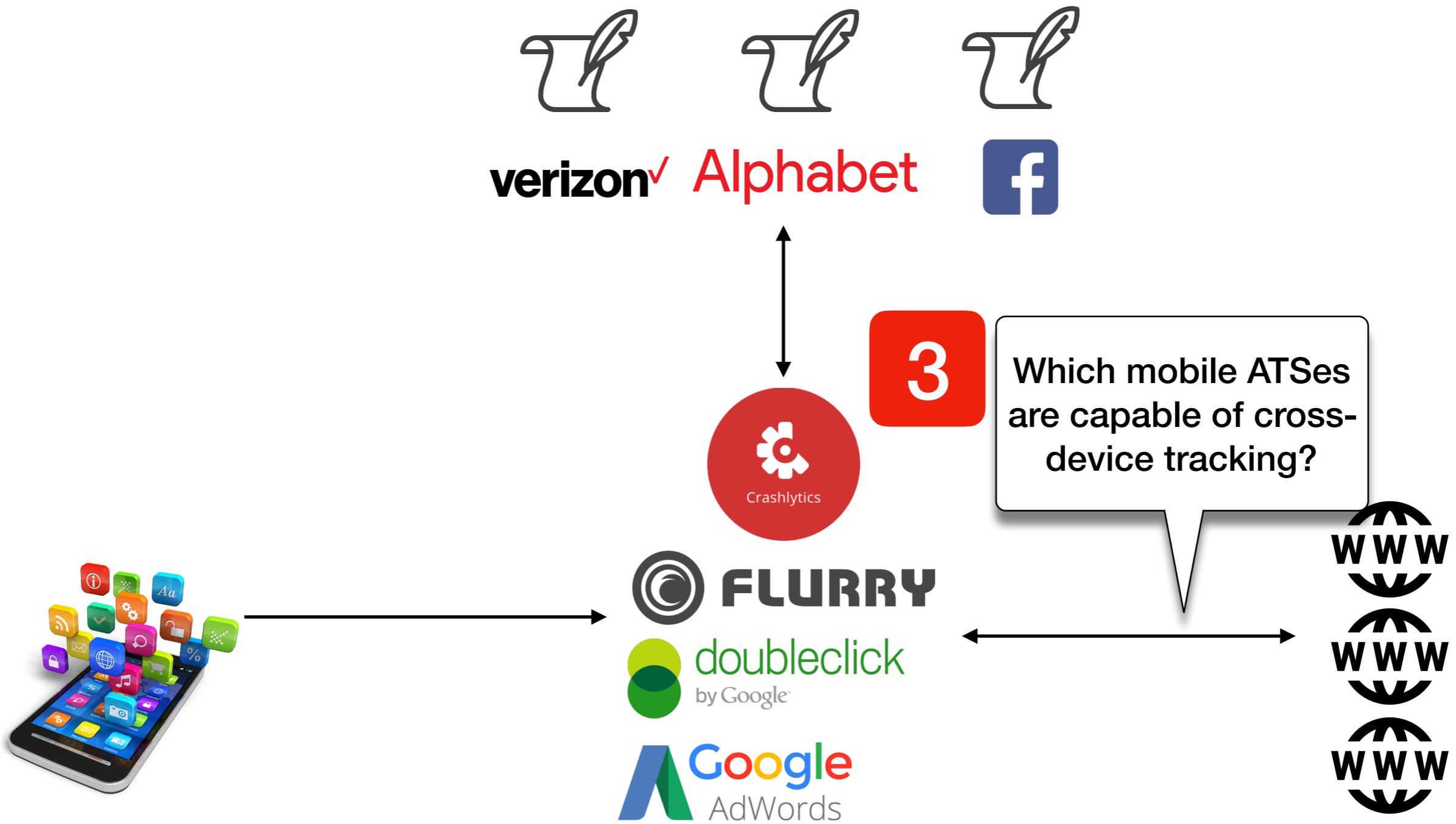
#4

verizon✓doubleclick
by Google

Crashlytics

**Aol.****YAHOO!**

Questions to answer



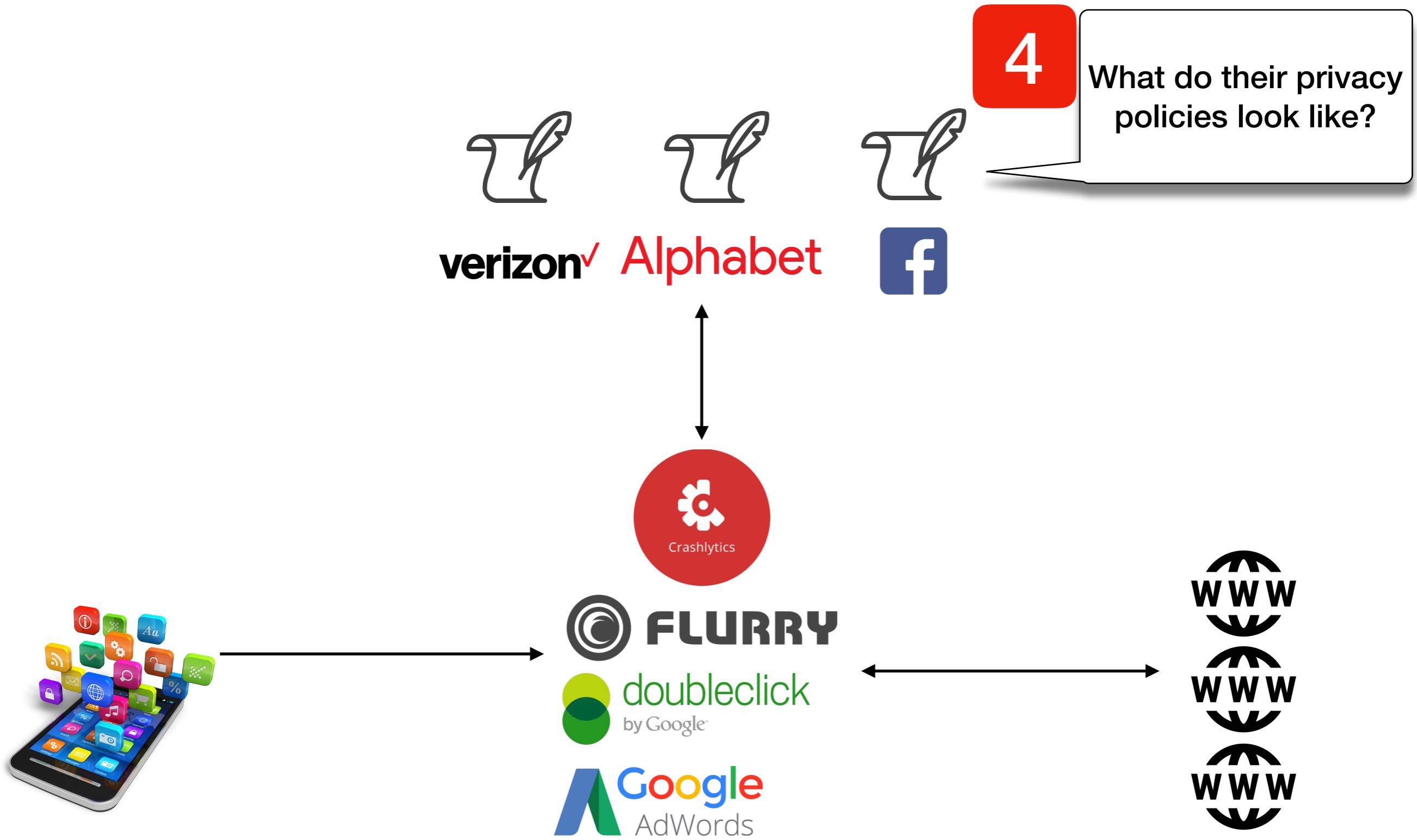
Cross-device Tracking

```
-    return -1 != k.indexOf("Google Web Preview") || 1E-4 > Math.random()
}),
ra = function() {
  try {
    a: {
      var a = e.document.querySelector("script[nonce]");
      if (a) {
        var b = a.nonce || a.getAttribute("nonce");
        if (b && oa.test(b)) {
          var c = b;
          break a
        }
      }
      c = void 0
    }
    return c
  }
  catch (d) {}
};
var r = function() {
  return e.googletag || (e.googletag = {})
},
var u = {
  1: "pagead2.googlesyndication.com",
  2: "pubads.g.doubleclick.net",
  3: "securepubads.g.doubleclick.net",
  173: "pubads.g.doubleclick.net",
  174: "securepubads.g.doubleclick.net",
  7: .02,
  13: 1500,
  23: .001,
  24: 200,
  27: .01,
  29: .01,
  33: "pagead2.googlesyndication.com",
  37: .01,
  50: .01
};
```

Cross-device Tracking

- 15 out of top 20 parent organizations are also present in popular websites
- Cross-device tracking is already the norm!
- Users don't know their activities can be tracked across devices

Questions to answer



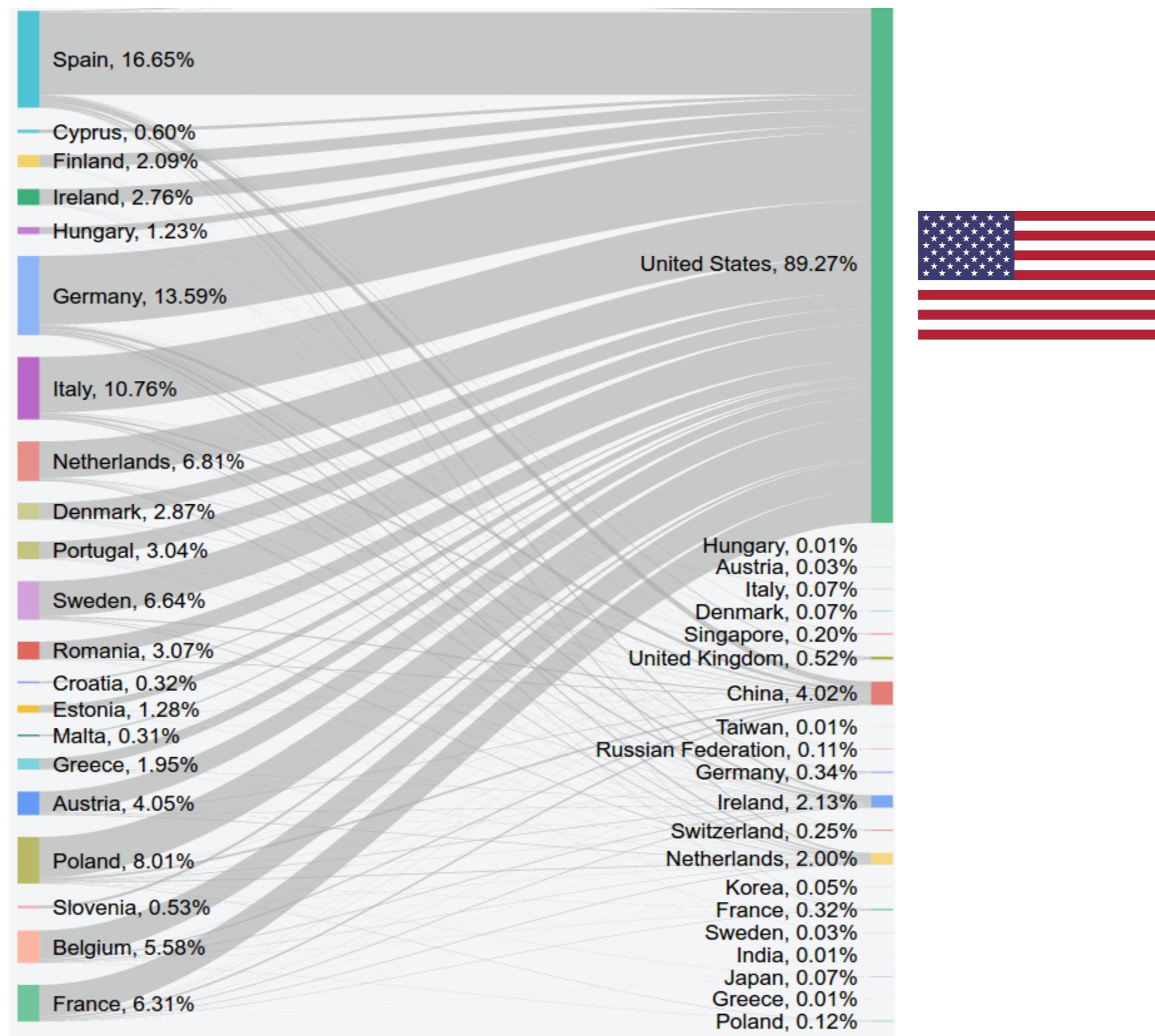
ATS Privacy Policies

Company	Has ad subsidiaries?	Data sharing with subsidiaries?	Data sharing with 3rd-parties?	Opt-out
Alphabet	✓	✓		Account settings
Facebook	✓	✓		Account settings
Twitter	✓	✓	✓	Account settings / DAA
Verizon	✓	✓	✓	Account settings
AppsFlyer			✓	Email
ChartBoost	✓	✓	✓	NAI/DAA webforms
Vungle	✓	✓	✓	Google ID Reset
AppLovin	✓	✓	✓	TRUSTe/EU YOC
Adjust			✓	NAI webform
Alibaba	✓	✓	✓	Webform

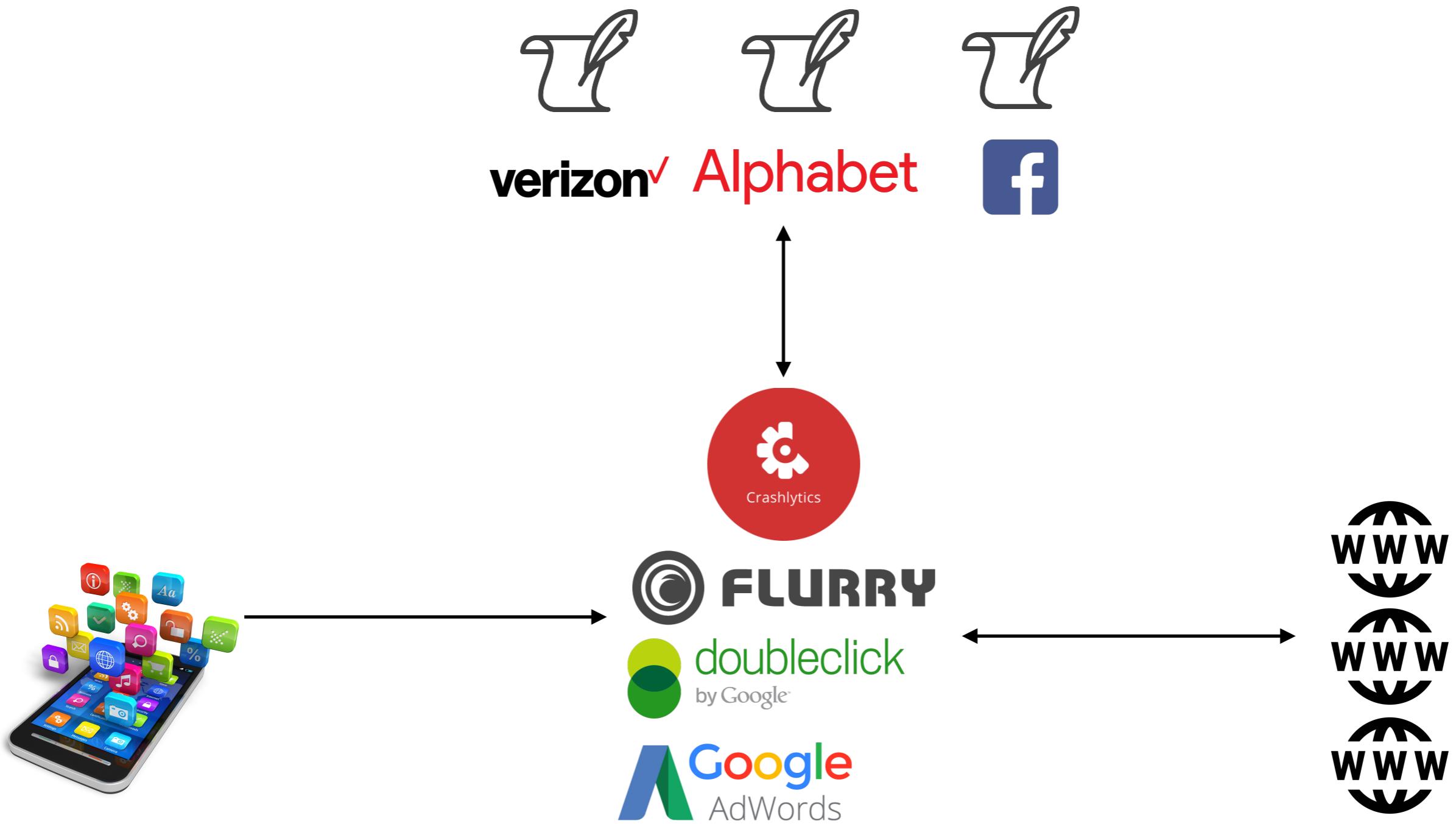
NAI: Network Advertising Initiative

DAA: Digital Advertising Alliance

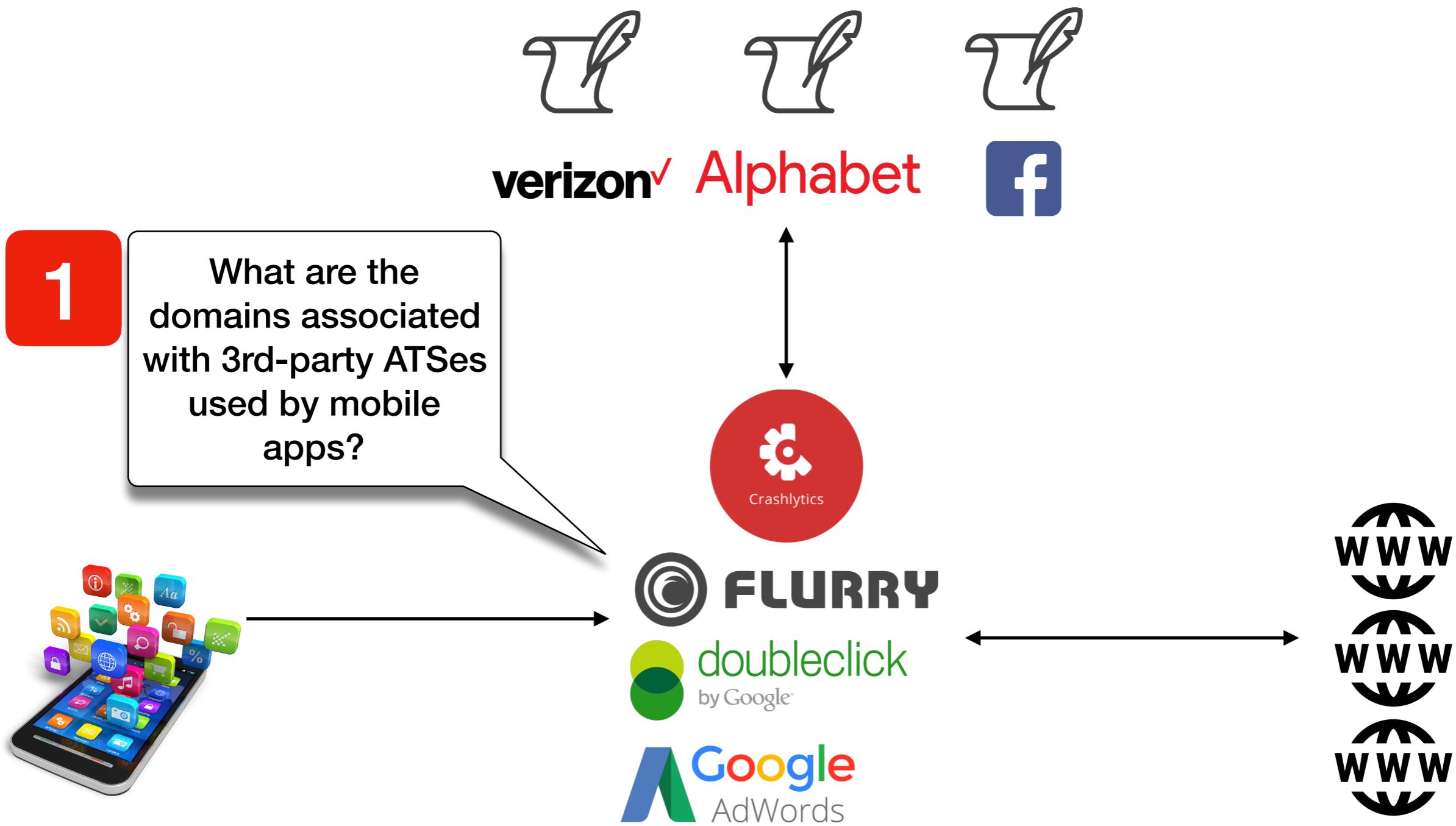
Trackers without borders



Questions to answer



Questions to answer



Questions to answer

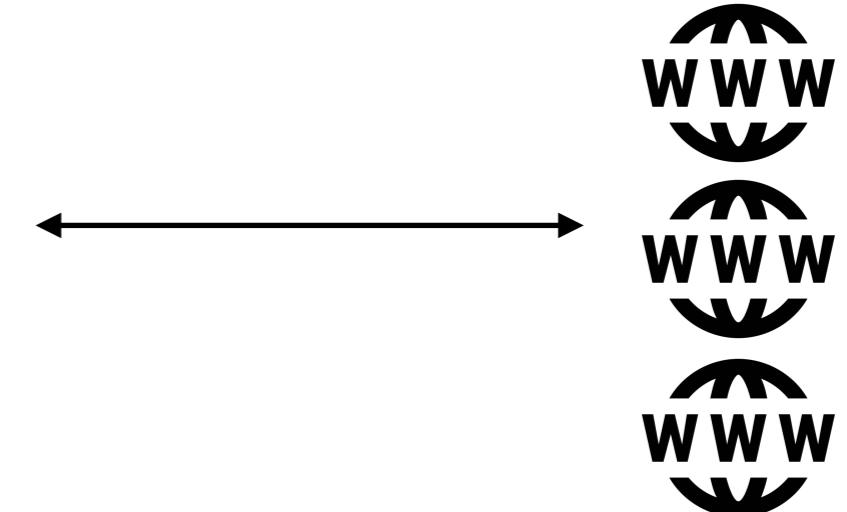
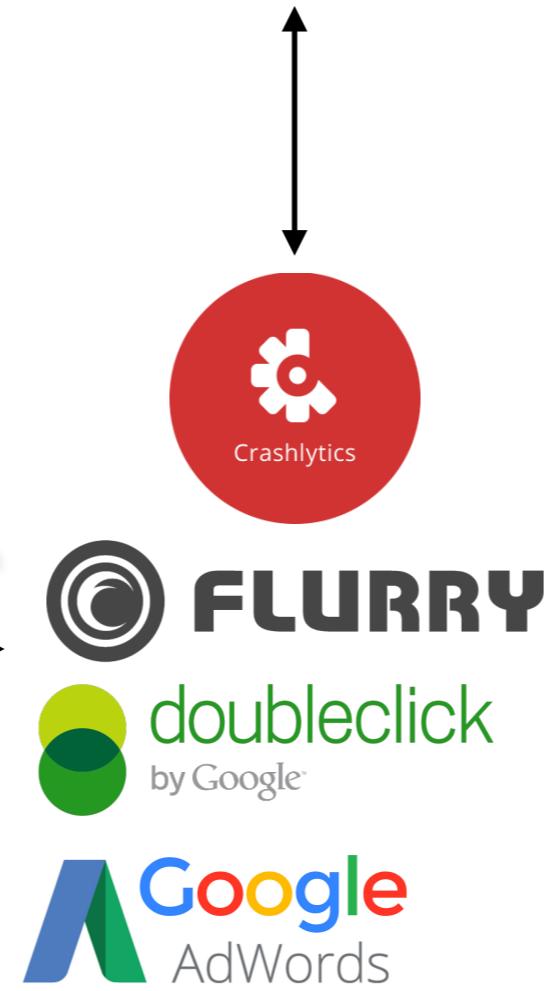
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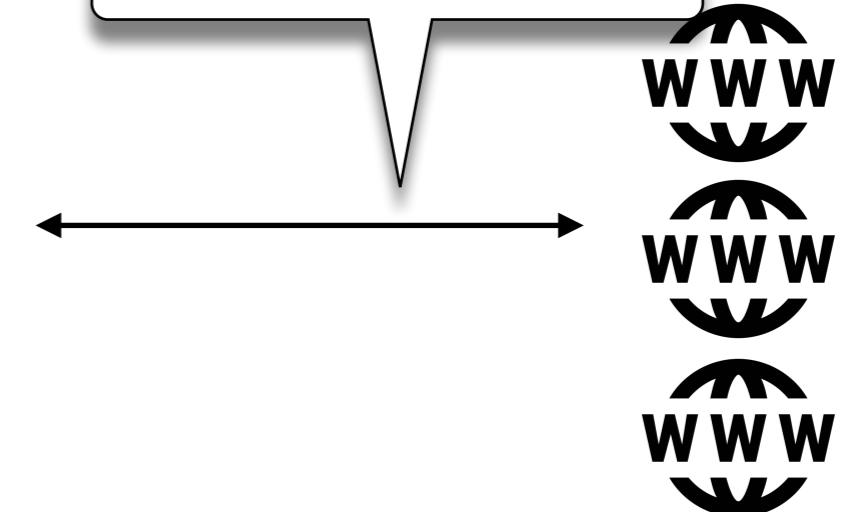
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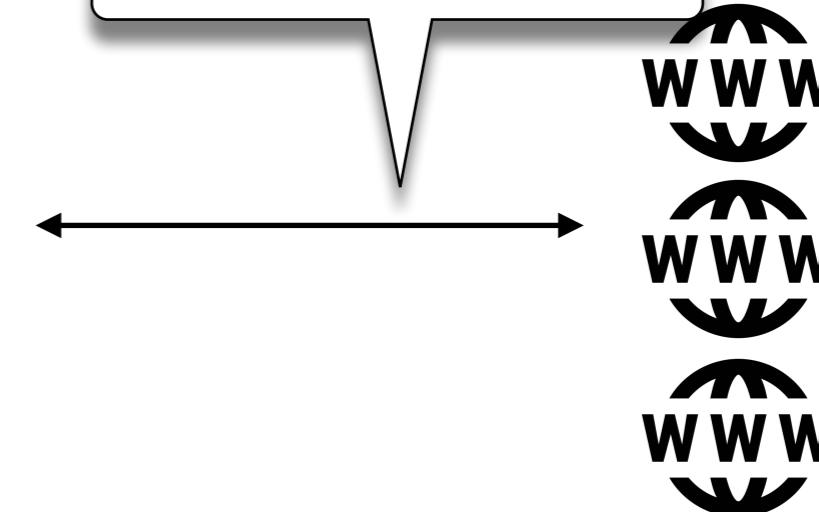
Which mobile ATSes are capable of cross-device tracking?



FLURRY

doubleclick
by Google

Google
AdWords



Summary

- Identified **2,123** mobile ATSes using an automated mechanism to identify ATS domains, **233** of which were unreported by Web-based lists
- Found mobile ATS presence in the Web to be pervasive
- Identified **292** parent organizations running mobile ATSes
- Top 10 parent companies allow either inter- or intra- organizational data sharing
- Most mobile ATSes may be affected by proposed regulations in the EU



arazaghpanah@cs.stonybrook.edu



haystack.mobi